OLIVE STREET RAILROAD BRIDGE
Olive Street over AMTRAK
New Haven
New Haven County
Connecticut

HAER No. GT-58

HAER
CONN
5-NEWHA,
53-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Northeast Region
U.S. Custom House
200 Chestnut Street
Philadelphia, PA 19106

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HISTORIC AMERICAN ENGINEERING RECORD

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Location: Olive Street over AMTRAK
New Haven
New Haven County, Connecticut

UTM: 18.674190.4574910
Quad: New Haven, Connecticut, 1:24000

Date of Construction: 1907

Engineer: New York, New Haven & Hartford Railroad

Fabricator: Milliken Brothers

Present Owner: State of Connecticut
Department of Transportation
24 Wolcott Hill Road
Wethersfield, Connecticut 06109

Present Use: Vehicular bridge

Significance: Olive Street Railroad Bridge is significant as a representative example of the standard rivet-connected, steel truss technology of the 20th-century, and as part of extensive early 20th-century improvements to the state's most important rail corridor, the New Haven Railroad's mainline.

Project Information: The Connecticut Department of Transportation plans to replace the bridge, due to its poor physical condition. This documentation was completed in December 1991, fulfilling a stipulation in a Memorandum of Agreement executed on July 9, 1991.

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Description of the Bridge

The Olive Street Railroad Bridge across the AMTRAK mainline in New Haven, Connecticut, built in 1907, is a steel double-intersection Warren through truss with sub-ties. The maximum length of the truss is 139'. The 29'-wide roadway accommodates two lanes of vehicular traffic. Vertical clearance at the portals is approximately 16'. Steel I-section outriggers support sidewalks along both sides of the bridge.

The railroad right-of-way is four tracks wide and runs in a cut below the level of the surrounding neighborhood, which is a densely built residential and commercial area of low-rise frame buildings. The bridge offers about 30' of clearance above the tracks. The right-of-way was owned by the New York, New Haven & Hartford Railroad, commonly called the New Haven Railroad, until that company's demise in the 1960s. Presently, the tracks are part of the Boston-New York corridor owned and operated by the National Railroad Passenger Corporation (AMTRAK); these tracks also accommodate freight service provided by the Consolidated Rail Corporation (CONRAIL) and passenger commuter service operated by the Connecticut Department of Transportation.

The truss is asymmetrical in most details, the result of fitting the structure into a curving, irregular, and tightly constrained right-of-way. At this location the railroad angles from a north-south alignment to a northeast-southwest alignment. Also, at Olive Street the railroad right-of-way narrows from 151' to 136'; since the railroad engineers had to place the abutments at the limits of the property in order to accommodate four sets of tracks, the abutment faces are not parallel. Finally, Olive Street crosses the railroad at an angle of 31 degrees. The combination of the curving alignment, the non-parallel abutment faces, and the angled crossing resulted in large and different end skews of 51' and 60'. The west side of the truss, at 139', is some 11' longer than the east side. In order to avoid excessive warping of the portals, the engineers made the end panels of each web identical, at 13'-1/2". They then utilized that same panel length as much as possible for the remaining panels of both webs, and completed the webs with odd panel lengths to fill in the remaining distances. The longer (west) web has a total of twelve panels, with eight (including the end panels) of 13'-1/2" and four middle panels of 8'-9". The shorter (east) web has a total of ten panels, with eight of the standard size and two, in the middle, of 11'-11".

The differences in web and panel length did not prevent the use of members in fully standardized configurations, except, of course, for their lengths. The truss is made up of the following members:

> Upper chord and inclined end posts: box girder, 16" x 20", formed from angles at each corner with double interior plates on each side, cover plate on top, and lacing on the bottom.
>
> Lower chord: box girder, 10" x 16", formed from angles with double side plates and an added plate welded across the top.
>
> Hip verticals, sub-ties, and end diagonals: two sets of paired angles connected by lacing.
>
> Center diagonals: paired channels connected by lacing.
>
> Portal struts and top lateral bracing: pairs of angles at top and bottom, connected by a lattice web of angles (portal struts) or lacing bars (top lateral bracing).

All original connections are riveted, using large gusset plates.

The floor system was extensively reconstructed in both 1932 and again in 1968. The floor beams, installed in 1932, are plate girders assembled with high-strength bolts instead of the rivets characteristic of earlier practice; the rolled I-section sidewalk brackets are bolted to the ends of the floor beams. The floor beams hang from new brackets installed at the same time; these brackets are welded and bolted to the pre-existing web at the bottom panel points, and protrude slightly above the paving. The rolled I-section stringers, corrugated-steel subfloor and reinforced-concrete deck all date from 1968.

The reinforced-concrete abutments are incorporated into the retaining walls that run along either side of the railroad right-of-way to the east of the bridge. Immediately west of the bridge, the tops of the abutments angle down sharply to a height of some 3' above the railroad grade. The seats for the trusses are 24'-3" above the railroad grade. The inside (visible) abutment faces are battered slightly, at 1/2" per foot. The rear faces that are hidden within the embankment are stepped back one foot of depth for every three foot of height; total abutment depth is 12'-6" at the bottom and 3'-3" at the top.

From three of the portal joints (all but the northwest corner), rise lattice-girder towers that carry transmission wires for the railroad's electrified traction system. The fourth tower is mounted atop the upper chord, four panels in from the northwest portal, another consequence of the end skews that complicated the design of this crossing. The angle-section cross-members and porcelain insulators carry transmission lines to Cedar Hill Freight Terminal, about one and one-half miles north of this site.

Historical Context

Olive Street Railroad Bridge is significant at the state level for its role in the transportation and engineering history of Connecticut. It was built at a time of tremendous expansion by the New York, New Haven, & Hartford Railroad, commonly known as the New Haven Railroad. Formed in 1872 as a consolidation of two smaller companies with their origins in the 1830s, the New Haven Railroad controlled most of the trackage in Connecticut. In the last quarter of the 19th century, the New Haven bought, leased, or merged with nearly every other railroad in southern New England. Its routes included not only the original New Haven-Hartford line, but also the so-called "Air Line," from Boston to New York through Middletown (CT), and the Boston-New York "Shore Line" (the present Northeast Corridor). All these lines converge at New Haven to form the rail corridor that passes under this bridge. Running north from New Haven Union Station through the densely built-up commercial and industrial area immediately east of downtown New Haven, this corridor became known as the "New Haven Cut." That name referred to its elevation of between 25 and 30 feet below the level of the surrounding streets.

The New Haven Cut was an enormous bottleneck to street traffic in the early 20th century. In the early 20th century, the growth of commerce, industry and population in New Haven increased street traffic and brought new demands for more bridges, with wider roadways and gentler grades. The New Haven Railroad accordingly reconstructed the Cut between 1905 and 1907, building 13 new bridges -- seven plate girders, five concrete arches, and this truss at Olive Street.

The railroad specified single-span girder bridges for crossings under 50 feet, and multiple-span reinforced-concrete arches for longer crossings. The New Haven Cut project was the laboratory for the railroad's engineers in the design and construction of concrete bridges. They preferred it for its low cost, ease of maintenance, and because if finished properly the concrete would not trap soot and gases, which was a problem with trusses and girders. The five arches on the New Haven Cut were among the first structures of their type in the state, and represented the state's first comprehensive program of concrete-bridge construction. For Olive Street, however, a truss offered the only suitable alternative. The span length was too great for the standard girder bridges, and the need to fit four tracks in the limited right-of-way precluded the use of the piers required in the multiple-span concrete design. This bridge is thus a unique component of the New Haven Cut improvements of 1905 to 1907.

Technological Significance

Though asymmetrical in all its panel lengths, Olive Street Railroad Bridge typifies the standard bridge engineering which had evolved by the early 20th century. The bridge uses the Warren configuration which, along with the Pratt truss, had become almost universal, replacing the myriad of patented trusses that had characterized the 19th century. Similarly, its material, steel, had superceded wrought iron, and the use of riveted connections had replaced the pinned method in all but the largest of trusses.

The bridge is unusually rugged for a highway bridge of this size and period. The large size of the members, the use of subverticals to divide the panels, and the double-web system all derive from its origin in a railroad engineering department. Railroads were accustomed to designing for much higher loads than highway engineers, and they favored multiple-web designs because of their greater rigidity. Rigidity was important in railroad bridges because a relatively slight deflection could result in derailment.

This bridge was over-designed not simply from habit but also because of the absolute need to protect the right-of-way from accidents. Because three major passenger lines, as well as virtually every freight car moving through New Haven, passed under the bridge, an accident could shut down the entire rail system in New Haven.

The Designers and Builders

The New Haven Railroad's in-house engineering team performed the basic design for Olive Street Railroad Bridge and all the other structures on the New Haven Cut. W. H. Moore, Chief Bridge Engineer, had the primary responsibility for Olive Street, and was assisted by C. L. Slocum, Assistant Engineer of Construction. Slocum supervised the site survey, as well as locating and designing the abutments. Moore derived the truss geometry and set the overall size and profile of the steel members. The railroad then forwarded the plans to the structural fabrication and erection contractor, Milliken Brothers Co., of New York City. Milliken Brothers draftsmen completed the design by delineating the size of all the components for the built-up members, determining the size and location of every rivet and rivet hole, and specifying which joints would be completed in the shop and which would be completed in the field.

Foster and Edward Milliken began their careers in 1882 as New York agents for Phoenix Iron Works. After completing a tutorial in civil engineering under a professor from Columbia University, Foster Milliken began to take design contracts for bridges and buildings. In 1887 the Millikens established the firm that bore their name. Over the next 18 years the company multiplied in size, built the largest structural-fabricating facility in New York City (on Court Street, Brooklyn), and built monumental structures throughout North America, Europe, Africa, South America and the Pacific Islands. Among the firm's many notable projects from this period were the National Theater in Mexico City, and the renowned arch-cantilever bridge on Costa Rica's Northern Railroad, which had a central span of 600'. In 1905 Milliken Brothers began construction of its own steel mill on Staten Island, an ambitious scheme that strained the firm's finances to the point of collapse in 1907. Before that bankruptcy, however, the company completed its most prominent structure, the Singer Building on lower Broadway in Manhattan. Designed by Ernest Flagg, the Singer Building was said to be the world's tallest structure upon its completion in 1907 (it was demolished in 1970). The Olive Street contract came at the precise time of Milliken Brothers' greatest accomplishment. Though the bridge was a relatively small job, the New Haven Railroad was a significant client, with the potential for substantial further work for Milliken Brothers. But Milliken Brothers went bankrupt at the end of 1907, due to cost overruns in building the Staten Island facility. The creditors kept the company running at reduced capacity for another ten years before it folded completely, the same fate that awaited the New Haven Railroad a generation later.

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Sketch Map